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EXAMINER
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ALHIJA, SAIF A

ART UNIT	PAPER NUMBER
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2128

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

Application No.

10/742,695

Applicant(s)

QADEER ET AL.

Examiner

Saif A. Alhija

Art Unit

2128

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 24 October 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1 and 3-22 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 and 3-22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 19 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

Art Unit: 2128

**DETAILED ACTION**

1. Claims 1 and 3-22 have been presented for examination.

Claim 2 has been cancelled.

**Response to Arguments**

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 24 October 2007 has been entered.

Applicant's arguments filed 24 October 2007 have been fully considered but they are not persuasive.

i) Applicant argues the 101 rejections of claims 1 and 3-22 however the merits of the rejections have not been addressed, specifically the mixing of statutory categories, therefore the rejections are maintained.

ii) Following Applicants arguments and amendments the 112 2<sup>nd</sup> rejections are withdrawn.

iii) Applicant argues that the reference does not disclose "generating the partial procedure summary of the procedure from the plurality of the actions atomically modelable with respect to multithreaded execution of the multithreaded software, wherein the partial procedure summary comprises at least one state pair, wherein the at least one state pair models execution for the procedure, and wherein the partial procedure summary of the procedure of multithreaded software is embodied on a second computer-readable medium." Tyrells Figure 2 and description of state transitions in Section III read on the claims as presented. The action/process diagrams read on the modeling of procedure execution. Applicants have not argued the patentable distinction between the prior art and the claims as presented but merely recite that one of ordinary skill in the art would not be expected to surmise. As can be seen on page 630 and Figure 1-2 the model is analyzed in at least a process recovery diagram, Fig. 2, an action diagram, Fig. 2, and further on page 633, right column, first paragraph of section III recites the analysis of the modeled system. This reads on the limitations as presented.

iv) Applicant argues that the reference does not disclose "analyzing actions of the multithreaded software, wherein the analyzing comprises checking the modeled multithreaded software for programming flaws." Section III further discusses error detection, as well as the Abstract and intent of the reference dealing with error

Art Unit: 2128

detection as well as recovery. Further the last paragraph of Section I states the placement of “fault tolerance software structures” as well as the references discussion of multiple processes reads on the claims as presented.

v) Applicant argues that the reference teaches away based on state space boundaries. It is unclear how the references discussion of “error propagation by communication” teaches away from the claims as presented.

vi) Applicant argues that the reference does not disclose “a plurality of state pairs representing a procedure summary for multithreaded software.” As stated previously, this can be seen in at least Figure 2a, with respect to object y before and after state A2 and in Figure 2c, process R before and after state A3 as per Applicants definition of a state pair in the specification of the instant application.

vii) Examiner has cited particular sections in the references applied to the claims for the convenience of the applicant. Although the specified citations are representative of the teachings of the art and are applied to specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully requested from the applicant in preparing responses, to fully consider the references in their entirety as potentially teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or disclosed by the Examiner.

viii) The Examiner respectfully requests, in the event the Applicants choose to amend or add new claims, that such claims and their limitations be directly mapped to the specification, which provides support for the subject matter. This will assist in expediting compact prosecution.

ix) Further, the Examiner respectfully encourages Applicants to direct the specificity of their response with regards to this office action to the broadest reasonable interpretation of the claims as presented. This will avoid issues that would delay prosecution such as limitations not explicitly presented in the claims, intended use statements that carry no patentable weight, mere allegations of patentability, and novelty that is not clearly expressed.

**Claim Rejections - 35 USC § 101**

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Art Unit: 2128

**MPEP 2106 recites:**

The claimed invention as a whole must accomplish a practical application. That is, it must produce a "useful, concrete and tangible result" State Street 149 F.3d at 1373, 47 USPQ2d at 1601-02. A process that consists solely of the manipulation of an abstract idea is not concrete or tangibles. See *In re Warmerdam*, 33 F.3d 1354, 1360, 31 USPQ2d 1754, 1759 (Fed.Cir. 1994). See also *Schrader*, 22 F.3d at 295, 30 USPQ2d at 1459.

3. **Claims 1 and 3-22 are rejected under 35 U.S.C. 101** because the claimed invention is directed to non-statutory subject matter.

i) Claims 1, 3-14, and 21-22 recite a computer program product as well as a method. This represents a mixing of statutory categories. Since it is unclear to which statutory category the claim belongs the claims are rendered non-statutory.

ii) Claims 15-18 recite a computer program product as well as a system. This represents a mixing of statutory categories. Since it is unclear to which statutory category the claim belongs the claims are rendered non-statutory.

iii) Claims 19-20 explicitly state software elements as well as data structures. As such the claims are drawn to a computer program and data manipulation which does not produce a useful, concrete, and tangible result. For example, claim 19 states computer media encoded with a data structure containing state pairs, which falls under mere data manipulation. The issue with claims 19-20 lies in the that they do not produce a "useful, concrete and tangible result." For clarification purposes the mere data manipulation discussed in claims 19-20 does not produce a "useful, concrete and tangible result." It is unclear where the structural and functional interrelationships are recited in the claims.

Appropriate correction is required.

All claims dependent upon a rejected base claim are rejected by virtue of their dependency.

**Claim Rejections - 35 USC § 102**

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

Art Unit: 2128

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. **Claims 1 and 3-22 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Tyrrell et al. "CSP Methods for Identifying Atomic Actions in the Design of Fault Tolerant Concurrent Systems", hereafter Tyrrell.**

**Regarding Claim 1:**

The reference discloses A computer program product embodied on a first computer readable medium and comprising code that when executed causes a computer to perform a method of generating a partial procedure summary of a procedure of multithreaded software, wherein the procedure performs a plurality of actions when executed, the method comprising:

identifying a plurality of the actions as atomically modelable with respect to multithreaded execution of the procedure; (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions.

**Figure 1-2)**

generating the partial procedure summary of the procedure from the plurality of the actions atomically modelable with respect to multithreaded execution of the multithreaded software, wherein the partial procedure summary comprises at least one state pair, wherein the at least one state pair models execution for the procedure, and wherein the partial procedure summary of the procedure of multithreaded software is embodied on a second computer-readable medium. (Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 2.)

**Regarding Claim 3:**

The reference discloses The computer program product of claim 1 further comprising:

modeling execution of the software via the partial procedure summary. (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Figure 1-2)

**Regarding Claim 4:**

The reference discloses The computer program product of claim 3 further comprising:

Art Unit: 2128

during modeling, comparing an indicated state invariant with a modeled state; (**Figure 1-2. Page 630, Left Column, Paragraph 2, “Thus all processes in the atomic action cooperate in error detection.”**)

responsive to determining the modeled state fails the indicated state invariant, wherein determining the modeled state fails the indicated state invariant comprises determining that a condition is false for at least one execution path, indicating that a programming flaw is present in the software. (**Page 630, Left Column, Paragraph 2, “Thus all processes in the atomic action cooperate in error detection.”**)

**Regarding Claim 5:**

**The reference discloses** The computer program product of claim 1, wherein the at least one state pair comprises an initial state and a resulting state, wherein the resulting state comprises at least one of a plurality of possible states of the multithreaded software after execution of the modeled procedure, the method further comprising:

storing an initial program counter location within the modeled procedure for the initial state;  
storing a resulting program counter location within the modeled procedure for the resulting state; and  
associating the initial program counter location within the modeled procedure and the resulting program counter location within the modeled procedure with the partial procedure summary. (**Page 630, Section II, Left Column, Last Paragraph, Boundaries and entry/exit lines**)

**Regarding Claim 6:**

**The reference discloses** The computer program product of claim 1 further comprising:  
performing a reachability analysis of the software; and  
consulting a procedure summary comprising the partial procedure summary when the procedure is encountered during the reachability analysis, wherein the consulting comprises determining possible execution paths within the procedure and using the procedure summary to explore possible states. (**Page 630, Right Column, Section III, First Paragraph, Reachability Graph/Petri Net**)

**Regarding Claim 7:**

Art Unit: 2128

**The reference discloses The computer program product of claim 1 wherein the identifying comprises identifying a transaction boundary within the actions. (Page 630, Section II, Left Column, Last Paragraph, Boundaries)**

**Regarding Claim 8:**

**The reference discloses The computer program product of claim 1 wherein the identifying comprises identifying at least one of the plurality of actions as movable later in time with respect to actions executed by other threads without affecting a resulting end state.(Page 631, Left Column, Paragraph 3, Timelines and Time Critical Systems)**

**Regarding Claim 9:**

**The reference discloses The computer program product of claim 1 wherein the identifying comprises identifying a sequence of actions having zero or more right movers followed by an atomic action followed by zero or more left movers. (Page 630, Section II, Left Column, Last Paragraph, Atomic Actions. Page 632-634, Algorithms/Interleaving and Elements S/F/K)**

**Regarding Claim 10:**

**The reference discloses The computer program product of claim 1 wherein the plurality of actions atomically with respect to multithreaded execution of the software is a subset of the plurality of actions of the procedure, the subset comprising less than all of the plurality of actions of the procedure. (Page 632-634, Algorithms/Interleaving and Elements S/F/K)**

**Regarding Claim 11:**

**The reference discloses A computer program product embodied on a computer readable medium and comprising code that when executed causes a computer to perform a method of modeling multithreaded software, the method comprising:**



Art Unit: 2128

analyzing actions of the multithreaded software, wherein the analyzing comprises checking the modeled multithreaded software for programming flaws; ( See Section 2.iv above) and

based on the analyzing, generating a plurality of procedure summaries for the multithreaded software, wherein the plurality of procedure summaries for the multithreaded software is embodied on a second computer-readable medium;

wherein the procedure summaries comprises a plurality of modeled states of the multithreaded software for multithreaded execution of the multithreaded software. (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)

**Regarding Claim 12:**

The reference discloses The computer program product of claim 11 wherein at least one of the procedure summaries comprises at least two or more partial procedure summaries summarizing a procedure. (Page 633, Figure 3-4. Parallel processing and interleaving summaries.)

**Regarding Claim 13:**

The reference discloses The computer program product of claim 11 wherein at least one of the procedure summaries comprises at least one partial procedure summary for a procedure, wherein the partial procedure summary summarizes less than all of the procedure. (Claim Interpretation. A summary by definition is less than what it summarizes. Page 633, Figure 3-4. Parallel processing and interleaving summaries.)

**Regarding Claim 14:**

The reference discloses The computer program product of claim 11 wherein the evaluating comprises: identifying a series of transactions within the multithreaded software; (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2) and

Art Unit: 2128

modeling the transactions via partial procedure summaries. (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)

**Regarding Claim 15:**

The reference discloses A computer program product embodied on a first computer readable medium and comprising code that when executed causes a computer to implement a system for modeling multithreaded software, the system comprising:

a model checker operable to analyze a model of the multithreaded software via checking the model of the multithreaded software for programming flaws, ( See Section 2.iv above) the model checker comprising:

the model of the multithreaded software, wherein the model comprises a plurality of procedure summaries modeling states of the multithreaded software during multithreaded execution of the multithreaded software, wherein the model of the multithreaded software is embodied on a second computer-readable medium. (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)

**Regarding Claim 16:**

The reference discloses The computer program product of claim 15 wherein at least one of the procedure summaries comprises a procedure summary summarizing actions deemed to have occurred one after another without interruption. (Claim Interpretation. Actions occurring without interruption is the definition of an atomic action. Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Figure 1-2)

**Regarding Claim 17:**

The reference discloses The computer program product of claim 15 wherein the model checker further comprises:

Art Unit: 2128

a reachability analyzer operable to employ the procedure summaries to generate modeled states of the software. (Page 630, Right Column, Section III, First Paragraph, Reachability Graph/Petri Net

**Regarding Claim 18:**

The reference discloses the computer program product of claim 17 wherein the system is operable to detect programming flaws via comparing an indicated state invariant with the modeled states. (Page 630, Left Column, Paragraph 2, "Thus all processes in the atomic action cooperate in error detection.")

**Regarding Claim 19:**

The reference discloses A computer-readable medium having encoded thereon a data comprising:  
a plurality of state pairs representing a procedure summary for multithreaded software, wherein at least one of the state pairs comprises an initial state and a resulting state indicating a state after execution of actions modeled by the procedure summary, wherein the procedure summary models multithreaded execution of the multithreaded software. (Figure 2, State Space Diagram)

**Regarding Claim 20:**

The reference discloses. A computer-readable medium of claim 19 wherein the state pairs comprise the following:

an indication of a first location within the procedure and an indication of a possible state for one or more variables of the multithreaded software when the procedure has reached the first location; and (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)

an indication of a second location within the procedure and an indication of a resulting state for the one or more variables of the multithreaded software after a plurality of summarized actions of the procedure have been executed, wherein the summarized actions start at the first location and end at the second location; (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)

Art Unit: 2128

wherein the plurality of summarized actions of the procedure are atomically modelable with respect to multithreaded execution of the multithreaded software. (Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)

**Regarding Claim 21:**

The reference discloses. The computer program product of claim 1, wherein the at least one state pair comprises an initial state of the procedure and at least one of a plurality of possible states of the multithreaded software after execution of the modeled procedure. (See rejection for claim 1)

**Regarding Claim 22:**

The reference discloses The computer program product of claim 1, wherein the first computer- readable medium comprises the second computer-readable medium. (See rejection for claim 1)


**Conclusion**

5. All Claims are rejected.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Saif A. Alhija whose telephone number is (571) 272-8635. The examiner can normally be reached on M-F, 11:00-7:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini Shah can be reached on (571) 272-22792279. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
SPE 2128

Application/Control Number: 10/742,695

Page 12

Art Unit: 2128

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January 5, 2008